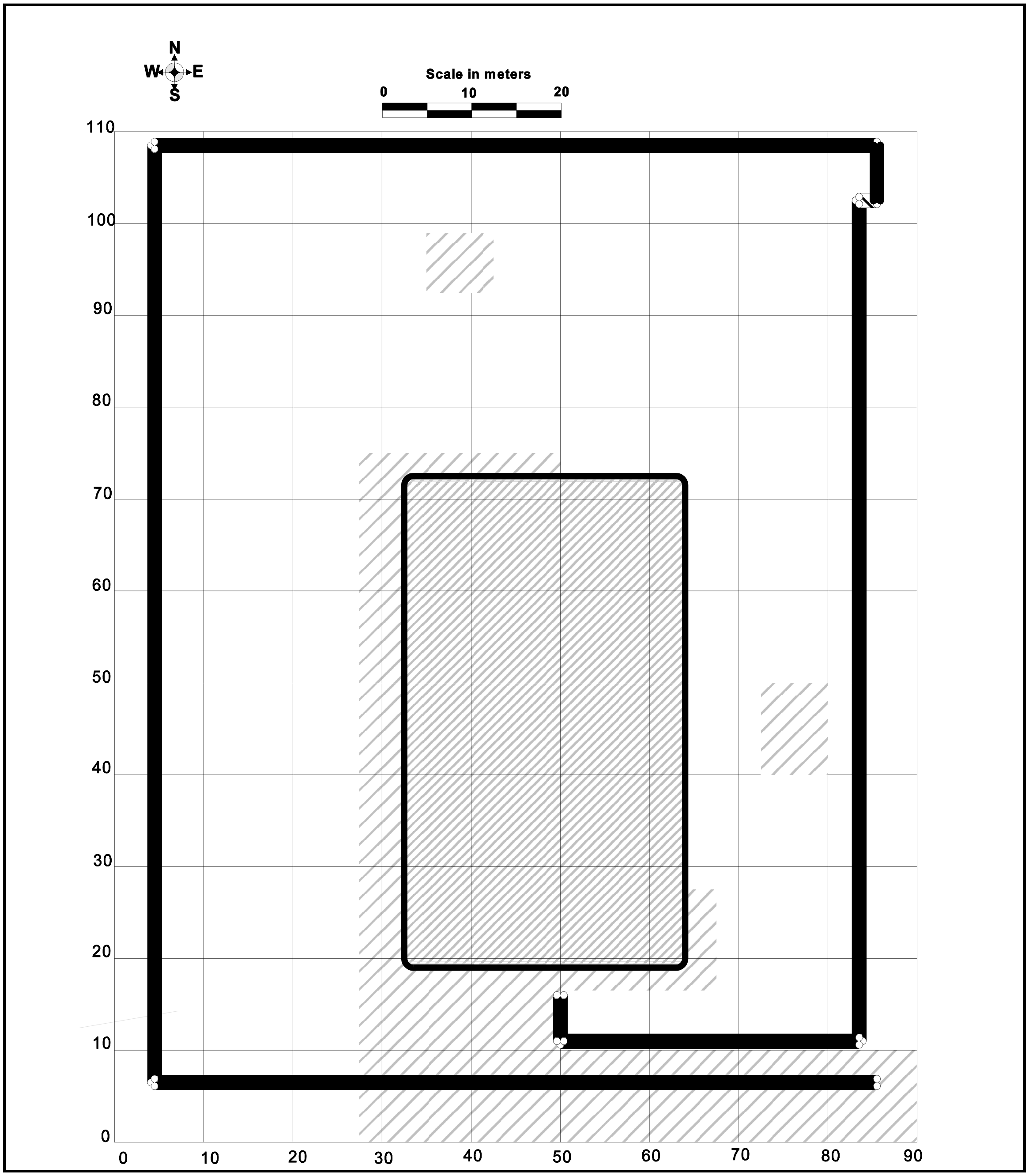

Figure 3.2 Sample Outdoor Reference Coordinate System

One procedure for constructing a reference coordinate system is to draw a map of the area to be sampled and a rectangle that encloses it. Define a coordinate system for locating points (X,Y) within the rectangle, e.g., the number of meters east, X, and the number of meters north, Y, from the southwest corner (0,0) of the rectangle. The northeast corner will then have coordinates (X_{max}, Y_{max}). Note that the local coordinate system need not line up with the principal compass points. It may be convenient to align one of the axes with a site boundary or other local feature.

For the example in Figure 3.2 the coordinate system has been laid out in the north-south and east-west directions. There are 9 ten-meter east-west coordinates, and 11 ten-meter north-south coordinates. The total area is 9,900 m^2, of which approximately 9,000 m^2 is the affected area within the fence line. The soil area to be surveyed is about 4,500 m^2. The remainder of the area is covered by buildings, walkways, etc., which will be part of other survey units.

3.5.4 Sampling Grids

Sampling locations in Class 1 and Class 2 survey units are laid out on random start systematic grids. The essential procedure for determining where samples should be taken in either reference areas or survey units is the same. On a site map, a reference coordinate system is laid out as in Section 3.5.3, with enough detail to locate positions with an error that will be small compared to the distance between samples. A square or equilateral triangular systematic sampling grid pattern is superimposed on the coordinate system. The length, *L*, of a side of either the square or the triangle used to generate the pattern, is the distance between sampling locations. This distance is determined by the total number of samples or measurements to be taken. This number, n, is calculated to satisfy the requirements of the statistical tests and is discussed in Section 3.8.1. The length (or spacing), *L*, of the systematic pattern is given by:

$$L = \sqrt{\frac{A}{0.866\ n}} \quad \textit{for a triangular grid,}$$

and

$$L = \sqrt{\frac{A}{n}} \quad \textit{for a square grid}$$

where *A* is the area of the survey unit.

After *L* is determined, a random coordinate location is identified as the starting location for the survey pattern . Beginning at the random starting coordinate, a row of points is identified, parallel to the X axis, at intervals of *L*.

For a *square* grid, the second and subsequent rows of points are spaced at intervals of length *L* along the Y axis.

For a *triangular* grid, the second row of points is located parallel to the first row, but at a Y-axis distance of 0.866*L* from the first row. The survey points along the second row are located midway (on the X-axis) between the points on the first row. This process is then repeated to fill out the triangular pattern across the survey unit.

If points are identified that fall outside the survey unit or at locations which cannot be surveyed, additional points are determined, using the same random process as was used to determine the starting point, until the desired total number of points is identified.

An example based on Figure 3.2 is shown in Figure 3.3. The procedure used for a laying out the triangular sampling grid for the soil area survey unit is as follows:

(1) Locate a random starting point by drawing two random numbers from a uniform distribution on the interval [0,1]. Random numbers can be generated using the random number function of a spreadsheet or a scientific calculator. Table A.6 contains 1000 random numbers generated using a spreadsheet, and similar tables can be found in many statistics texts. Choose any starting point in the table, and then take numbers consecutively either across rows or down columns. For example, in Table A.6, starting at row 23 in column 2 and working down, the two numbers 0.93062 and 0.029842 are found. Scale the first number by the length of the east-west coordinate axis to get 83.76 = (90)(0.93062). Round the coordinates to the nearest values that can be easily measured in the field (e.g., nearest meter). This gives 84 meters to the nearest meter. Similarly scale the second number by the length of the north-south coordinate axis to get 3.28 = (110)(0.029842) or 3 meters to the nearest meter. This gives (84,3) as the starting coordinate for the sampling grid. Since this does not fall within the area to be sampled (it falls on an area of asphalt), the next two random numbers (0.863244,0.921291) are taken, giving (78, 101). Continue until a point that falls within the sampling area is obtained. In this case (78, 101) does fall in the area to be sampled. The points are shown on Figure 3.3.

(2) Compute the spacing, *L*, of the sampling locations on the triangular grid using the number of sampling locations required, *n*, *rounded down* to the nearest meter. Rounding down helps assure that the requisite number of sampling points are identified on the sampling grid.

$$L = \sqrt{\frac{A}{0.866n}} = \sqrt{\frac{4500}{(0.866)(17)}} = 17.5 \text{ meters} \approx 17 \text{ meters}$$

Note that the area, *A*, is the net area of the survey unit, i.e. with buildings and paved areas that are not part of the soil area survey unit subtracted.

(3) From the starting location, lay out a row of sampling points parallel to the X-axis and distance *L* apart, as is shown in Figure 3.3.

(4) To start additional rows, locate the midpoint between two adjacent sampling locations on the sample row and mark a spot at a distance

$$0.866\sqrt{\frac{A}{0.866n}} = \sqrt{\frac{(0.866)(4500)}{(17)}} = 15.14 \text{ meters} \approx 15 \text{ meters}$$

perpendicular to the row. Again, this number should be rounded *down* if necessary. This is the starting location for the new row. This is also shown in Figure 3.3.

(5) Continue until all grid points within the sampling area have been located. Ignore any sampling locations that fall outside the area to be sampled. The completed sampling grid is shown in Figure 3.4.